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PHYSIOGRAPHIC NOTES.

BY

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PALEOZOIC APPALACHIA.—The Maryland Geological Survey has more nearly solved the problem of the proper field for a State survey than has been done in any other State. Too much credit cannot be given to Prof. Clark for the breadth of view which has characterised his administration of the affairs of the Survey. The reports are written by high-grade specialists; they are well edited and beautifully printed; and they cover not only the standard subjects of stratigraphic and economic geology, but also the physiographic aspect, which most surveys still ignore. Moreover, they are papers of great educational value, because they deal with subjects of general interest written in clear, untechnical language, and therefore capable of being read by intelligent laymen and used by geography teachers. Of the latter class of papers Willis's Paleozoic Appalachia (*Maryland Geological Survey*, *Special Publication*, Vol. IV, Part I), is an excellent example.

Willis's paper is prefaced by a statement of some fundamental geological processes under the headings: Illustrations of Erosion; Illustrations of Sedimentation; Illustrations of Deformation; and Relations of the Three Processes. This is followed by a statement of the Paleozoic history of Maryland and the adjacent States, applying the principles of geology to an interpretation of the development of the region. The long, complex, and interesting geological history has already been made familiar to geologists by the work of various observers, but it has never been so clearly and delightfully presented as in this paper, which starts with the Paleozoic era, when

> the region comprised a sea and a land. The sea lay west of the land; the land stretched eastward beyond the present extent of the continent. The shore along which the western sea met the land migrated during ages far eastward and again far westward, with many minor oscillations back and forth, and the areas of land and sea shrank and expanded, each in opposition to the other. The land may be called the continent of *Appalachia;* the sea was the mediterranean of North America.

From this time Willis traces the development step by step, showing the complex history of sedimentation, vulcanism, deformation by mountain-folding forces, and denudation down to the present time. One who reads this paper cannot fail to gain a clear view of the origin and development of the present Appalachian structure. Nor can he but be impressed with the intimate dependence of man upon physiography and of physiography upon geology—a point well stated by Willis in the closing paragraph, as follows:

> The detail of mountain and valley sculptured on the upraised mass is determined by the arrangement of the strata laid down in the vanished Paleozoic sea. The geography, the atmosphere, and the life of that distant time determined initially the plan of the present landscape. They conditioned human existence. Broad farmlands or craggy crests, fertility or sterility, mineral leanness or wealth, the courses of highways and the sites of cities—all the conditions of man's physical environment, are related in the Appalachians to the long Past, even to the remote Past of the era of ancient life.

THE CANADIAN ROCKIES.—Few American geologists have had a more favourable opportunity for the study of broad physiographic features in a large section of almost unknown country than the late Dr. George M. Dawson. Many of his observations and generalisations have been published in various reports, but recently there has appeared a broad summary of the physical history of the Canadian Rockies as his Presidential address before the Geological Society of America (*Bull. Geol. Soc. Amer.*,Vol. 12, 1901, pp. 57–92), unfortunately one of his last utterances upon geology.

On either side—that is, both east and west—of an Archean axis extensive deposits of sediment were accumulated, reaching in the western geosyncline a total depth of over 89,000 feet, in the eastern or Laramide geosyncline over 46,000 feet. All ages, from the Cambrian to the Pliocene, are represented in this great thickness of strata, though it is not probable that the strata were ever actually superimposed at one place or time in the western geosyncline, though no doubt they did attain the full thickness in the eastern geosyncline. During various ages there was extensive extrusion and intrusion of volcanic materials, so that with the sediments there is much igneous rock. Again and again folding occurred parallel to the border of the Pacific basin, causing great changes in the relative level of the land and sea. The force of compression acted from the Pacific side, the greatest recent uplift, and the one from which the present structure has been largely derived, occurring in the period of early Tertiary, as elsewhere in the Rocky Mountains.

This great mass of disturbed rock, with its complex history, has naturally been subjected to tremendous denudation, in part due to its position on the eastern border of a great ocean, where, in northern latitudes, an excessive rainfall must have occurred at all periods on the seaward mountain ranges. No comparable denuding forces were probably ever operative on the east side of the continent in similar latitudes since the definition of the ocean basins of the Pacific and Atlantic.

Profound subsidence has admitted the sea into the deeply-carved valleys, forming the wonderful fjords along the western coast of Canada.

THE PHYSIOGRAPHY OF ACADIA.—Dr. Daly's paper (*Bulletin of the Museum of Comparative Zoology*, Vol. XXXVIII [Geological Series, Vol. V, No. 3], pp. 73–104, 1901) is a welcome contribution, for it is the first attempt to interpret the physiography of Nova Scotia upon the basis of the modern conception of the subject. It has long been known that the general physiographic development of the Nova Scotia peninsula has resembled that of New England, or, as Daly says, that

> as regards axial trends, formational composition, and structure, the uplands and lowlands from Georgia to Gaspé belong to one system.

Mountain-folding of Paleozoic date has introduced very complex geological structure, as in the eastern United States; and the subsidence of the Bay of Fundy region has permitted the accumulation of thick beds of sediment, among which, as in the region to the south, are included the Triassic rocks. These broad points in the geological history of the region are well known; but Daly carries the study further into details, and, as would be expected from one of the Harvard School, especially along the lines of subaërial denudation.

The main object of Dr. Daly's paper is to bring forward evidence that the Acadian land-forms have been twice reduced to the peneplain condition,

> each (peneplain) a nearly perfect plain of denudation, interrupted by incised valleys and surmounted by residual hills.

These plains are believed by Dr. Daly to be due to denudation that was essentially subaërial. He discusses the alternative hypothesis of bevelling, but does not find that it applies to this region; nor does marine denudation seem to be competent to explain the facts. The Nova Scotia region, therefore, resembles the New England region in physiographic history, as might be expected. This correspondence in history in the two regions is clearly brought forward in a table of parallel columns—one for Acadia, the other for New England—and the resemblance between the two is striking.

Even one who does not thoroughly agree with Dr. Daly in his interpretation of the facts cannot fail to be impressed with the great value of the paper as a statement of important fact and a masterful discussion of the subject. It stands as one of the best contributions to the literature of peneplains, now quite extensive; and, like several papers by Prof. Davis, it is distinguished from many others in the fact that it considers the question whether it may not be possible to adopt some other explanation. Whatever may be the fate of the peneplain explanation, it is certain that many so-called peneplains will not stand the test of real investigation; and that if the explanation is established, for a particular region, it will not be upon the basis of affirmation—a means which not a few American geologists are still employing. Rather it will be by such careful discussions as Dr. Daly's paper, the several papers by Profs. Davis, Hayes, and Campbell, and a very few others.

THE PREGLACIAL DRAINAGE OF OHIO.—The interference with the pre-existing drainage by the glacier and its deposits has led to many perplexing problems upon which physiographers have been long at work. The problem is especially perplexing from the fact that critical sections are often completely obscured by drift; but in those States, such as Ohio, where many borings have been made for oil and gas, the problem offers opportunity for solution. The paper before us (*Ohio State Academy of Science, Special Papers:* No. 3, Dec., 1900) contains contributions from four investigators—Messrs. Tight, Bownocker, Todd, and Fowke—whose studies were made possible by the research fund established by the wise generosity of Mr. Emerson McMillin. Each paper deals with a specific region, and is illustrated by a map showing the interpretation which its author places upon the drainage peculiarities of his district. Much of the discussion is of purely local interest, the point of general interest being the very large number of changes in stream-courses resulting from glacial deposits in pre-existing valleys. As a result of these changes the drainage of the State has become different from that of preglacial times, not merely in detail, but in many fundamentally important respects. The most important of these diversions is that previously described by Chamberlain and Leverett, by which the entire upper Ohio, above New Martinsville, was withdrawn from the Erie drainage and added to the Ohio. Could the preglacial drainage of the State be restored there would need to be numerous changes in the industries of the region. For example, numerous towns now located on good-sized streams would find themselves either on divides or else on small tributaries, and cities now connected with the sea by the Ohio and Mississippi would be on small streams tributary to the St. Lawrence system.

OLD CHANNELS OF THE MISSISSIPPI IN SOUTHEASTERN IOWA.—In a recent paper under the above title Leverett (*Annals of Iowa*, April, 1901, Vol. V, pp. 38–51) says:

> One would think that a stream which has been dignified by the title "Father of Waters" would be one that had shown evidence of exceptional stability rather than a bent toward vagrancy. But the Mississippi has been truly a vagrant stream; sometimes it has been forced from its bed by the intrusion of ice in the glacial winter, and sometimes by the accumulations of its own dirt or sediment. It has been shifting not only in the middle portion on the borders of Iowa, but in its lower and upper portions as well. So many have been its wanderings that only a part of them are as yet understood.

After briefly describing the various advances and retreats of the ice, Leverett takes up the question of the old drainage, which is so obscured by deep drift deposits that it is difficult to interpret. Then follows a consideration of the effects of the various advances of the ice upon the Mississippi drainage, closing with a statement of the changes which have occurred since the Iowan stage of advance. During this stage the loess was deposited, apparently in some vital way connected with the great streams of the region. The loess filled the valley on the border of Iowa so that the stream flowed near the level of the top of the present bluffs fully a hundred feet above its present level. An elevation followed, and the streams began to deepen their channels; but they flowed in branching courses, as rivers do on a flood-plain, and at first the water began to cut various channels, one by one abandoned as the more direct valleys, or those which did not encounter rock, gained greater depth. The abandoned channels are still plainly seen.

While the course of the river is in large part in the old valley, in some cases it extends across rock walls, and there rapids are found. There seems little reason to expect further changes in the course; in fact, Leverett rather facetiously concludes his discussion by the following sentence:

> Indeed, in this upper part of the valley the "Father of Waters" seems to have settled down to a steady course, except at flood seasons, when it becomes too full to stay within bounds.